# DETECTION AND MAPPING OF VOLCANIC ROCK ASSEMBLAGES AND ASSOCIATED HYDROTHERMAL ALTERATION WITH THERMAL INFRARED MULTIBAND SCANNER (TIMS) DATA COMSTOCK LODE MINING DISTRICT, VIRGINIA CITY, NEVADA

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Summary

Thermal Infrared Multiband Scanner data were acquired over the Virginia City area on September 12, 1984. The Virginia City area is located in west-central Nevada about 20 miles south of Reno. The highest peak in the area is Mount Davidson which has an elevation of 7,850 feet. The surrounding Washoe and Carson valleys have elevations of 4,500 feet. The flight altitude above mean terrain was 20,000 feet. The data were acquired at approximately 1130 hours local time (1723 IRIG). There is approximately 40% vegetation cover in the area consisting of mostly juniper, sage and grasses.. The area is dominated by an assemblage of volcanic rocks that range in age from Tertiary to Quaternary. These volcanic rock assemblages also contain fluvial and lacustrine sediments of similar age. Unaltered volcanic rocks range in composition from andesite to rhyodacite and their percent silica by weight ranges from 55% to 65%. The volcanic rocks contain very little free quartz. Pre-Tertiary rock units consist of regionally metamorphosed sedimentary and volcanic rocks that have been folded and intruded by granitic rocks. The volcanic rock assemblages have been subjected to intense hydrothermal alteration that has produced secondary quartz, opal, and clay (Thompson, 1956). The historic Comstock Lode District is centrally located in the study area and it produced over 8 million ounces of gold and almost 200 million ounces of silver.

TIMS data have been analyzed using both photointerpretative and digital processing techniques. The Jet Propulsion Laboratory produced enhanced color images using a decorrelation contrast stretch technique. The color negatives were printed at 1:50,000 scale for field use. A VAX11/780 IDIMS image analysis system was used to analyze specific areas at 512 by 512 image resolution. Karhuen-Loeve transformations were utilized to display variations in radiant spectral emittance. The TIMS image data were compared with color infrared metric camera photography, Landsat TM data and key areas were photographed in the field. Only the south-eastern portion of the area has been field-checked in a reconnissance manner.

The Virginia Range consists mainly of intermediate composition flows, breccias, and tuffs of Miocene age. Rhyodacite is most common, however, basalt, rhyolite, and tuffaceous sedimentary rocks of Miocene and Pliocene age cover large areas. Mesozoic metasedimentary and metavolcanic rocks are exposed in places, mostly along the southern and eastern margins of the range. Mesozoic granite and Tertiary diorite and andesite porphyry intrude the younger metamorphic and volcanic rocks. Some domes of extrusive pumiceous rhyolite are present in the area.

Major structures in the Virgin City area are north-trending faults that show evidence of both normal and strike-slip movement (Hudson, 1984). A major east-west trending alignment of drainage intersects the north trending structures and this lineament could be related to a deep seated fracture system which controlled the development of the volcanic pile in the Virginia City area and also the development of Steamboat Springs in Washoe Valley. These structural controls provided the conduits for hydrothermal fluids which have altered the volcanic rock assemblages, and have in some instances facilitated the emplacement of mineralization.

The most recent study of hydrothermal alteration mineral assemblages at Virginia City was done by Hudson (1984). He defines seven major alteration types:

1. Propylitic Alteration: chlorite + albite +/- epidote +/- calcite +/- white mica (illite, montmorillonite, or mixed layered illite-montmorillinite) +/- quartz +/- actinolite

2. Illite-Montmorillinite Alteration: illite + montmorillonite + mixed-layered illite-montmorillonite + quartz

3. Kaolinitic Alteration: kaolinite + quartz

4. Alsic Alteration: Pyrophyllite + quartz + kaolinite +/- diaspore

5. Alunitic Alteration: alunite + quartz +/- diaspore

6. Silicification: quartz

7. Sericitic Alteration: sericite + quartz

Propylitic alteration is the most widespread alteration type. Sericitic alteration is confined to the western portion of the Virginia City area and it is often associated with stockwork quartz veins. Small zones of alunitic alteration are usually surrounded by kaolinitic and/or alsic alteration which in turn are surrounded by illite-montmorillonite alteration. Silification and stockwork quartz veining are structually controlled and are associated with sulfide mineralization (Hutsinpiller, 1985).

Unaltered andesitic rocks of the Alta formation and Kate Peak formation that have approximately 40% vegetative cover appear green on the imagery. Extensive propylitic alteration of these rocks appears to have a dark purple color. Argillic alteration and silicic alteration ranges in color from pink to dark red. Presence or absence of vegetation over altered rock units plays an important role in the degree to which colors, other than green, are displayed. In fact, where brush fires have occurred bright red colors are often displayed by the imagery, but the rocks are only slightly altered and contain little silica by weight percent. A large intrusive plug of biotite-hornblende andesite porphyry with a glassy groundmass (Sugarloaf) is largely unvegetated and appears dark purple on the imagery. Similar rocks having at least 40% vegetative cover appear green. An intrusive dome of Steamboat Hills rhyolite appears bright red on the slope facing the sun and light green on the slope facing away. Vegetative cover is more dense on the north-facing slope of this circular dome, but its composition does not change appreciably.

References

Hudson, D. M., 1984, Geology of the Comstock District, Story County Nevada: Unpublished manuscript, Mackay School of Mines.

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